

THE STEM AND BULB NEMATODE *DITYLENCHUS DIPSACI*

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INTRODUCTION: *Ditylenchus dipsaci* (Khün, 1857) Filipjev 1936 (Fig. 1) is an endoparasitic migratory nematode that attacks aerial parts, bulbs and tubers of plants, and its damage has been known since 1855.

MORPHOLOGICAL CHARACTERISTICS: *Ditylenchus dipsaci* females are 1,000-1,300 µm long and 35-40 µm wide. They have a stylet 10-12 µm long and a bottle shaped esophagus with a basal bulb which does not overlap the intestine. Their nerve ring is located at mid isthmus and their lateral fields are marked by four lines (2).

HOST RANGE AND DISTRIBUTION: *Ditylenchus dipsaci* has a very wide host range and has been reported from several countries in Africa, North and South America, Asia, Australia, Europe, India and Japan. This nematode does not occur in Florida, but does occur in North Carolina, Virginia and western states of the U.S. Major cultivated host plants include bulbous species such as African lily, garlic, hyacinth, narcissus, onion, leek, tulip, and non-bulbous ones such as alfalfa, broad bean, carnation, clover, corn, oats, peas, potato, rough-stalked meadow grass, rye, strawberry (Fig. 2), sugarbeet, and vetch (2).

BIOLOGY AND DAMAGE: *Ditylenchus dipsaci* invades the shoots of plants by entering the host through the stomata. The nematode colonizes parenchymal tissues where it feeds and reproduces. Each female may lay 200-500 eggs. Nematode feeding and movement causes large cavities in the infected tissues (Fig. 3). Nematode infestations are favored by wet conditions and mild temperatures (15-20 C), and are adversely affected by dry conditions and temperatures below 10 C and above 22 C (1,8). Under these unsuitable conditions the nematode survives as a quiescent fourth-stage juvenile in seeds, bulbs, and tubers and can be spread passively for long distances with these propagative plant organs or in reused irrigation water. In temperate regions, nematode density and damage increase in fall and diminish drastically in winter. Nematode density and damage increase again in early spring and decrease drastically in summer. *Ditylenchus dipsaci* is a serious parasite that can cause plant damage at initial density of <0.1 specimen/cc soil and complete crop failure (Fig. 4) at 1 nematode/cc soil (5).



Fig. 1. *Ditylenchus dipsaci* specimens. Scale bar= 250 µm.



Fig. 2. Stunted *D. dipsaci* infected strawberry (*Fragaria X ananassa*) plants with distorted and pimply leaves (foreground) compared to healthy and bloomy plants (background).

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RACES: To date, 25 *D. dipsaci* physiological races have been identified (5). Among them, the giant race (common in the Mediterranean basin) is particularly aggressive and has greater chromosome number ($2n = 54$) and female body length (1,700-2,200 μm) than the other races (24 chromosomes and body 1,000-1,300 μm long).

SYMPTOMS: Distortions and swellings of leaves and bulbs are the most common symptoms induced by *D. dipsaci* on bulbous plants (Figs. 5, 6, and 7). At late infestation stage, the plant may die and rot because of secondary invasion of other pathogenic bacteria and fungi. Nematode-infected strawberries have pimply leaves with short peduncles and a few deformed flowers and fruits (Fig. 2). In leguminous crops such as broad bean and pea, the nematode causes necrosis of the stem base (Fig. 8) and distortion of leaves, stem, buds, and pods. Fourth-stage juveniles accumulate at the necrotic stem base and inside the seeds (5). On alfalfa and rough stalked meadow grass (Fig. 9), the nematode induces distortion of the buds, chlorosis, swelling and loss of leaves (3). The nematode survives in the seeds and in the dried leaves of alfalfa. Distortion of leaves, suberosity of stem and scarce production of flowers are reported in nematode-infected carnation (4).

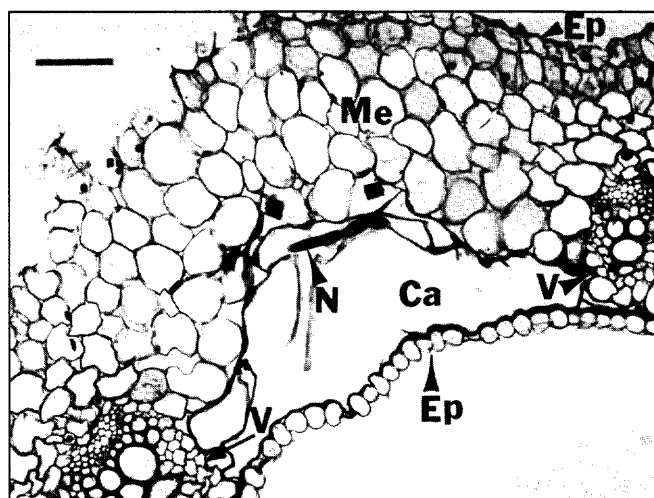


Fig. 3. Cross section of a garlic (*Allium sativum*) infected by *D. dipsaci*. Note a large cavity (Ca) in the mesophyll (Me) induced by the nematode (N) migration and feeding. Ep=epidermis; V=vascular bundle. Scale bar =150 μm .



Fig. 4. Large patches with stunted and sparse plants in an onion (*Allium cepa*) field heavily infested by *D. dipsaci*.

CONTROL METHODS: Quarantine regulations in several countries require that propagative materials such as bulbs, cuttings, seeds, and tubers of *D. dipsaci* host plants for commercial use are to be certified free of this pest. The use of certified propagative plant material in uninfested soils is the best preventive and economical measure to avoid nematode infestations.

Physical control methods, such as hot water treatment of bulbs and tubers (3-4 hours at 44-45 C) or strawberry runners (7 minutes at 50 C), are effective in controlling *D. dipsaci* without affecting plant viability (2).

Chemical control methods, such as dipping for 20 minutes in a 0.025% fenamiphos solution or treatment with methyl bromide at 1,000 mg/liter for 1 hour at 18 C and 75% of relative humidity, are effective in eradicating nematodes from infected bulbs and broad bean seeds, respectively (5).

Under field conditions, fumigant and nonvolatile nematicides are used successfully in some countries (5, 6, 7). However, these treatments are expensive and pose environmental and human risks. Soil solarization for 4-8 weeks is effective only in warm areas. Cultural practices effective in the management of this nematode include 2-3 year crop rotation with nonhost plants, weed control, wide row spacing, and replacement of overhead irrigation with drip irrigation. These cultural practices prevent nematode build-up in soil and spread among the plants.

SURVEY AND DETECTION: The outdoor climatic conditions of Florida are not favorable for the establishment of *D. dipsaci*. Winter (December-January) temperatures occurring in Florida can allow nematode infections; however, warm temperatures (>22 C) occurring in the remaining part of the year would likely prevent nematode infection and development. In the case of accidental introduction of *D. dipsaci* into Florida, nematode symptoms in the field may be observed only in the winter. During this season, host plants of the nematode with distorted and swollen leaves, such as strawberry, should be sampled and analyzed for the presence of the parasite.



Fig. 5. Two plants of African lily (*Agapanthus umbellatus*) distorted and deformed by *D. dipsaci* (right) and a slightly infected plant (left).



Fig. 6. Unmarketable garlics (*Allium sativum*) with distorted leaves and chaps due to *D. dipsaci* infection.



Fig. 7. Healthy (far left) and heavily *D. dipsaci* infected (right) onion (*Allium cepa*) plants.

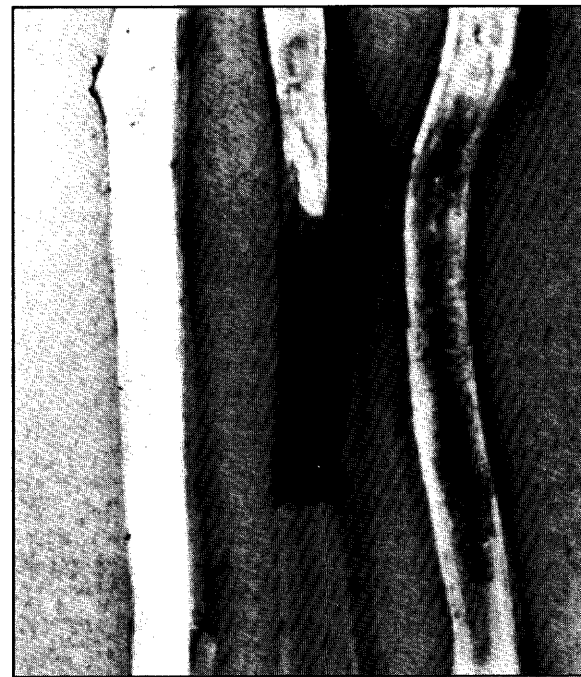


Fig. 8. External (center) and internal (right) necrosis of broad bean (*Vicia faba*) stems induced by *D. dipsaci*. Longitudinal section of a healthy stem (left).



Fig. 9. Rough-stalked meadow grass (*Poa trivialis*) with swollen and distorted leaves due to *D. dipsaci* infection.

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